

Functions of fats in food

There are large differences in both health characteristics and functional properties of the different types of fat. This fact sheet contains information about fats and oils in relation to their applicability in the production of foodstuffs. You can read more about the different fatty acids and their health characteristics in the fact sheet 'What is fat?'

THE FOLLOWING HAVE ALSO BEEN PUBLISHED IN THIS SERIES:

- What is fat?
- Consumer knowledge about fats
- Claims about fats
- The role of fats in the composition of taste

Functional properties

The functional properties of a triglyceride are determined by the chemical properties (such as chain length, the number of double bonds and the position of the double bond in the chain of carbon atoms) and physical properties (such as the melting point) of the particular fatty acids. The fatty acids that form the greatest proportion of the fat or oil determine the chemical and physical properties of the actual fat or oil. If a fat consists mainly of saturated fatty acids or trans fatty acids then these fatty acids determine the chemical and physical properties of the fat and it will be a solid at room temperature.

The fatty acid composition determines the physical properties such as the consistency and the melting point.

Functions of fats in products

There are many types of vegetable oils and fats that have a favourable fatty acid composition by nature. There have also been an increasing number of new techniques developed over time to modify existing vegetable oils and fats so that they can be made suitable for use in a wider range of applications in all sorts of foodstuffs. By combining different raw materials and techniques it is possible to modify the fats so as to influence the fatty acid composition of the end product.

Fats have an important function in many foodstuffs:

- fats give sensory satiety
- fats are important taste components
- fats make certain methods of food preparation possible, such as deep-frying and normal frying
- fats play a part in the transfer of heat and in the water activity of a product
- fats help to determine the consistency, the texture, the feel in the mouth and the melting behaviour

So fats determine to a large extent whether a product is found to be attractive.

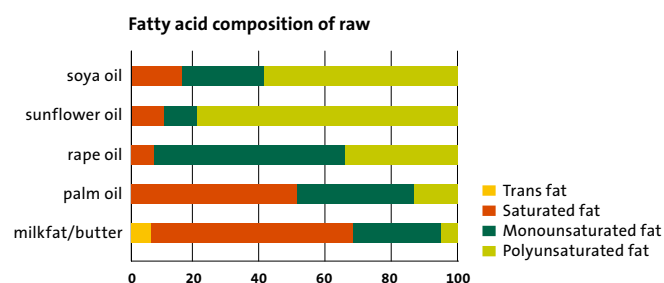
A certain degree of hardness of the fat is often needed for this. This hardness is needed for the structure and the stiffness. In the past fats with the desired degree of hardness were often saturated fatty acids

and/or trans fatty acids. Fortunately, innovations in the oils and fats sector have made it increasingly easier to produce foodstuffs using healthy fats but still with the desired taste, texture and shelf life.

The different oils and their fatty acid composition

There is a wide range of vegetable oils available, with diverse fatty acid compositions. The most commonly occurring are soya oil, palm oil, rape oil and sunflower oil (together forming about 80% percent of world production, see Figure 1), although oils such as safflower oil, coconut oil, olive oil, corn oil and palm kernel oil are also used a great deal in the foodstuffs industry. The oils differ from each other greatly in the fatty acid composition. Differences in the fatty acid composition within one particular type of oil can even occur according to season or per region. Therefore, it is usual to assume an average composition for the particular type of oil in order when characterising the type.

In order to apply a particular type of oil it is naturally important to know the differences between the types of oils well. It is always important to check each time what characteristics of the type of oil are wanted for the particular end product. By choosing the right raw material(s) as starting point an end product is obtained with a good fatty acid composition and at the same time a good taste and functional properties, with a good effect on health and a long shelf life.



Modification of oils and fats

It is sometimes desired to change the properties of an oil. This is also called modifying oils and fats. By using the right kind(s) of oils and by processing these it is possible to influence the fatty acid composition and the functionality of the end product to a large extent.

For example, by modifying a type of oil the melting range of that particular oil can be influenced. This is because the melting and the crystallization properties of an oil or fat are related to the fatty acid

The objective of the Product Board for Margarine, Fats and Oils (MVO) as knowledge centre is to disseminate reliable and balanced information about the role of fats in a healthy diet. This information complies with the policy of the Dutch government and the Dietary Guidelines (in Dutch: Richtlijnen Goede Voeding) from the Netherlands Health Council. It is also the objective of the Product Board to stimulate an improvement in the fatty acid composition of food.

Fact on Fats is a initiative of
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composition and to the distribution of the various fatty acids over the fat molecules or triglycerides. Important here is that saturated fatty acids have a higher melting point than unsaturated fatty acids (saturated fatty acids are more solid than unsaturated fatty acids at room temperature) and within the group of unsaturated fatty acids monounsaturated fatty acids have higher melting points (are more solid) than polyunsaturated fatty acids. The functionality of the end product can be adjusted even better by not simply modifying a single oil but instead a mixture of oils.

Three processes are used in the industry to modify oils, namely: hardening / hydrogenation, fractionation, interesterification

Hardening / hydrogenation

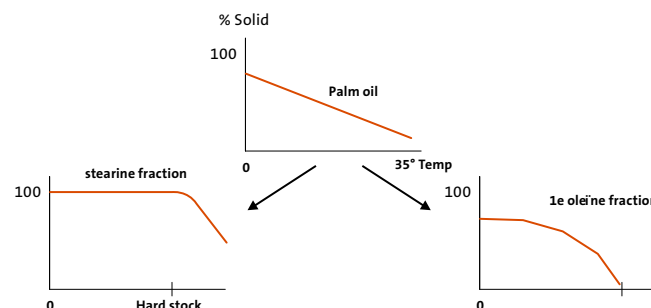
Thanks to hardening or hydrogenation it is possible to make fats with the desired solidity and the desired melting behaviour. Hardening or hydrogenation is a technique that has as aim changing the consistency of a fat. During this process hydrogen atoms are added to the unsaturated, double bonds in the fatty acid with the help of a catalyst. In the past trans fatty acids were produced during partial hydrogenation. Nowadays, only full hydrogenation is carried out and in this process no trans fatty acids are produced.

Fractionation

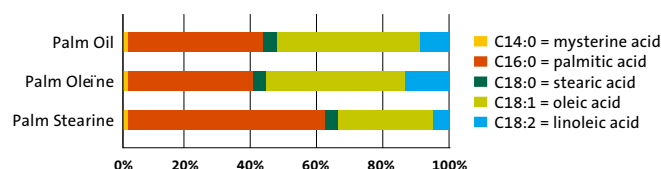
Fractionation is a technology whereby a fat is separated into different parts or fractions. Parts are separated off on the basis of different melting points of the different fractions, to produce products that have the desired functional properties or the desired fatty acid composition. Fractionation is usually used in order to separate the high melting point solid phase and the low melting point liquid phase of a basic raw material from each other. In this process an oil is cooled until crystals are formed. These crystals, that consist of triglycerides that will no longer dissolve in the rest of the oil, can then be removed from the oil using a filter. In this way two product fractions will always be formed, namely the high melting crystal phase, called the stearin, and the low melting oil phase, the olein. Fractionation is often used with palm oil in order to produce palm olein (liquid) and palm stearin (solid). Palm olein contains a relatively large amount of unsaturated fatty acids and is used a great deal for frying. Palm stearin is used a great deal in margarines to give them the right consistency (spreadability).

In many cases partially and fully hydrogenated fats are banned from foodstuffs in Great Britain, although they are allowed. This is based on the misconception that trans fats are automatically produced during the process. This is not the case, but is unfortunately often the common perception. Research has shown that hydrogenation of fats can result in a product with an improved fatty acid composition and thus with a more favourable effect on the cholesterol level than a non-hardened fat with comparable functional properties (source: Mensink, 2007).

Hardening/hydrogenation of fats also occurs in nature, namely in the stomachs of ruminants. A limited amount of trans fatty acids is formed during this process, which is the reason for the presence of trans fatty acids in milk and meat and products derived from this such as butter.



Fractionation of palm oil into a stearine fraction and an oleine fraction (palm oil, stearine fraction, 1st oleine fraction)



Fatty acid composition of palm oil and fractionated palm oil (oleine and stearine)

Intesterification

During interesterification the fatty acids are redistributed over all the triglyceride molecules in the oil or in the mixture of oils. During the process the fatty acid chains are effectively cut off the glycerol molecules and then reattached resulting in a different distribution over the glycerol molecules. This changes the physical and functional characteristics of the oil so that properties such as the stiffness and the melting behaviour are improved while still retaining the same fatty acid composition. A catalyst is used to instigate the process. A development that is attracting a great deal of attention at present is enzymatic interesterification, a form of interesterification in which enzymes play the role of catalyst.

Innovation for an optimal fatty acid composition

The use of oils and fats with an optimal fatty acid composition becomes increasingly possible by applying these techniques. The healthy fats are being made increasingly more robust and stable by applying innovative techniques. The techniques described above are themselves subject to continuous development so as to adapt the processes to the latest insights in the field of health aspects and functionality.

Each product requires a unique mixture of fats, so that it is not an easy process to improve the fatty acid composition of an end product. Modifications may be required to the work situation, the logistics and the production line. The recipe, the choice of raw material, the method of working, the preparation time etc. all have to be looked at. However, if the process is successful this can bring great health benefits. Various technical consultancies can assist in this process.